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SCIENTIFIC RESEARCH, FOREST ASSESSMENT AND DEVELOPMENT OF CRITERIA AND INDICATORS FOR SUSTAINABLE FOREST MANAGEMENT

Programme element III.1 (b): Methodologies for proper valuation of the multiple benefits of forests

Report of the Secretary-General

SUMMARY

The present document reports on implementation of decisions of the United Nations Conference on Environment and Development related to the first programme element of category III, "Scientific research, forest assessment and development of criteria and indicators for sustainable forest management", of the work programme of the Ad Hoc Intergovernmental Panel on Forests. As requested by the Panel at its first session, two reports have been prepared for this programme element. The first (E/CN.17/IPF/1996/6) deals with the assessment of multiple benefits of all types of forests. The second (the present report) presents an initial analysis of the methodologies for valuing the multiple benefits derived from forests. It includes a general overview of the issue, and a short update of its current status, and is followed by a description of the range of considerations for the substantive discussion of this programme element at the second session of the Panel.

The need to value realistically the goods and services of forests, forest lands and wooded lands has been recognized for quite some time but such valuation has seldom been seriously attempted. Indeed, it has been pointed out that a major cause of the failure of sustainable forest management, and even of deforestation and transfer of forests to other land uses, is the inadequate recognition and underestimation of the values of the many goods and

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services provided by forests at the local, the national, the regional and the global level. However it must be stressed that the application of valuation techniques in the real world faces the reality of actual forces influencing the fate of forests and pressures for land-use changes. The proper valuation of goods and services from forests provides information for decision-making but is not a panacea when addressing deforestation or forest degradation.

Valuation of forests is complex, as it involves issues of measurement of elements that escape the conventional approaches to economic analysis. The identification of values is also strongly influenced by the specific interest and perspective of the groups considered, whether they comprise the State, private owners or industries, local communities, or forest dwellers. Valuation should therefore be used to respond to questions that must be asked in pursuing sustainability while taking into account the variety of concerns of major players in forest management and utilization and in developing the dialogue among policy makers, interest groups and the public at large. Ultimately, valuation is a tool in making decisions about selecting orientations for forest management, recovering their full value and allocating land under forests in situations of competition with alternative use options. Undertaking the valuation of the goods and services of a forest at the local, national, regional and global levels is a complex and costly exercise that must be carried out in response to specific demands and guided by the type of decisions for which the results are to be used.

A review of the literature indicates an eagerness in attempting economic valuation. Studies whose aim was to value recreational goods and services were carried out in the United States of America as early as the late 1950s and 1960s. Recently, one may note a new and widespread interest in finding out what the value of forests might be, and also much confusion. This is hardly surprising, given the complexity of the issue and the practical problems in the way of establishing such values. Classical and neoclassical economic theory, on which conventional analysis bases its conceptual framework, did not pay attention to environmental dimensions. They were viewed as externalities or side-effects. Thus, conventional analysis has often failed to adequately capture many forest benefits that do not enter the market or cannot for other reasons be adequately valued in economic terms or are perceived in other sectors.

Values are classified as direct use values, indirect use values, existence value, and option (or non-use) value.

A number of valuation techniques are reviewed including market prices, efficiency (or shadow) prices, the hedonic pricing method, the travel cost method, the production function approach, the related goods approaches, constructed market techniques, and cost-based valuation. It is stressed that valuation is to be a neutral analytical tool and not an advocacy instrument.

Cost-based valuation considers indirect opportunity costs, restoration costs, replacement costs and relocation costs, as well as preventive/defensive expenditures.

The present review suggests that, from a technical point of view, there exists a large body of techniques, methodologies and approaches for dealing with forest valuation, although some of them are too theoretical, and difficult to apply as well as time-consuming and costly; and that some experiences of the application of valuation techniques exist from which lessons can be drawn. One must also stress that the application of even the most traditional valuation methods relies heavily on the availability of better data, part of which should originate from the assessment of forest resources. It is critical that the information not be restricted to the forest sector - that it should also be linked to other sectors that capture benefits generated by forests and woodlands.

It is suggested that the Panel may wish to pay special attention to deciding if it wishes to give priority to (a) the furthering of work on valuation stricto sensu which would imply that continuing efforts are justified by a demand for full valuation encompassing other dimensions than those incorporated in traditional methods in order to actually influence decisions or (b) the political issues raised once value is established, in other words how to direct serious attention towards the outcome of valuation, its application and the implications for decision-making and for reconciling the concerns of the various interest groups or stakeholders.

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INTRODUCTION

1. The present document reports on implementation of the decisions of the United Nations Conference on Environment and Development related to the first programme element of category III, "Scientific research, forest assessment and development of criteria and indicators for sustainable forest management", of the work programme of the Ad Hoc Intergovernmental Panel on Forests. As requested by the Panel at its first session, two reports have been prepared for this programme element. The first (E/CN.17/IPF/1996/6) deals with the assessment of multiple benefits of all types of forests. The second (the present report) presents an initial analysis of the methodologies for valuing the multiple benefits derived from forests. It includes a general overview of the issue, and a short update of its current status, and is followed by a description of the range of considerations for the substantive discussion of this programme element at the second session of the Panel.

2. The work under this programme element (III.1) is guided by the decisions taken at the third session of the Commission on Sustainable Development and further elaborated at the first session of the Ad Hoc Intergovernmental Panel on Forests.

3. The Commission, at its third session, defined programme element III.1 as consisting in the need to "review existing periodic assessment of forests, including relevant socio-economic and environmental factors, at the global level; identify shortfalls in present assessments relative to policy considerations; and recommend practical ways of improving such assessments. Examine ways to broaden the scientific knowledge and the statistical database available in order to better understand the ecological, economic, cultural and social functions performed by all types of forests. Promote the further development of methodologies for properly valuing the multiple benefits derived from forests in the form of goods and services, and subsequently to consider their inclusion within the system of national accounting, drawing upon work that has been already undertaken by the United Nations and other relevant organizations". 1/

4. Subsequently, the Panel, at its first session, emphasized the need for the preparation of two reports (see document E/CN.17/IPF/1995/3, para. 18 (III.1)):

(a) One would identify ways to expand on the Food and Agriculture Organization of the United Nations (FAO) Forest Resources Assessment with regard to the qualitative and quantitative assessment of all types of forests, including information on biological resources and non-wood forest products and services; information on environmental and social benefits; standardization of tropical and non-tropical data; collection of broader types of forest statistics; coordination of forest monitoring with remote sensing and geographical information systems; the continuous nature of the assessment; and the accessibility of information generated to all interested parties;

(b) The second report (this document) would consider ways to promote the further development of methodologies for properly valuating the multiple benefits derived from forests, in the form of goods and services, and

subsequently consider their inclusion within the systems of national accounts, drawing upon work that has already been undertaken by the United Nations and other relevant organizations and assessing progress in the application and incorporation of innovative approaches into national accounts. Consideration of this item should benefit from deliberations under programme elements IV, III.2 and other ongoing work undertaken in this field.

5. The science community should be involved in the preparations of these analyses in order to explore ways and means of enhancing the scientific basis for such assessments and valuations (see E/CN.17/IPF/1995/3, para. 18 (III.1)). At the first session of the Panel, it was decided to schedule programme element III.1 for substantive discussion at the second session, to be held in Geneva (11-22 March 1996).

6. This report was prepared by the Food and Agriculture Organization of the United Nations (FAO), in collaboration with the World Bank as lead agency for programme element III.1 (valuation) in consultation with the secretariat of the Ad Hoc Intergovernmental Panel on Forests in the Division for Sustainable Development of the Department for Policy Coordination and Sustainable Development of the United Nations Secretariat. In addition, contributions were received from the Centre for International Forestry Research (CIFOR).

7. This report is an initial response to the request of the Panel at its first session, taking into account the complexity of the subject and the fact that the Panel has programmed an initial substantive discussion at its second session, and a further substantive discussion at its third session. The report is on valuation methodologies but does not cover the inclusion of values within the systems of national accounting. It is meant to present in a concise manner some critical elements underlying approaches to valuation and a brief discussion of the status of current methodologies with a view to seeking the guidance of the Panel on the future development of work on this subject.

8. The issue of proper valuation of forest goods and services is closely linked to and in fact dependent on reliable information on the forest resource, information of both a quantitative and a qualitative nature including physical as well as socio-economic elements. In this sense, it must be stressed that the two topics under programme element III.1 of the work programme of the Panel, namely, forest resource assessment and the valuation of forests, are closely related even if they are distinct in nature.

9. The need to value realistically the goods and services of forests, forest lands and wooded lands has been recognized for quite some time but seldom attempted seriously. Indeed, it has been pointed out that a major cause of the failure of sustainable forest management, and even of deforestation and transfer of forests to other land uses, is the inadequate recognition and underestimation of the values of the many goods and services provided by forests at the local, the national, the regional and global the level. However it must be stressed that the application of valuation techniques in the real world faces the reality of actual forces influencing the fate of forests and pressures for land-use changes. The proper valuation of goods and services from forests provides information for decision-making but is not a panacea for deforestation or forest degradation.

10. Valuation of forests is complex as it involves issues of the measurement of elements that escape the conventional approaches of economic analysis. The identification of values is also strongly influenced by the specific interest and perspective of the groups considered whether they comprise the State, private owners or industries, local communities, or forest dwellers. Valuation should therefore be used to respond to questions that must be asked in pursuing sustainability while taking into account the variety of concerns of major players in forest management and utilization and in developing the dialogue among policy makers, interest groups and the public at large. Ultimately, valuation is a tool in decision-making as regards selecting orientations for forest management, recovering their full value and allocating land under forests in situations of competition with alternative use options. Undertaking the valuation of the goods and services of a forest at local, national, regional and global levels is a complex and costly exercise that must be carried out in response to specific demands and guided by the type of decisions for which the results are to be used.

11. In section I below, the report briefly sets the valuation of forests in context. Section II presents, in a concise manner, the methodologies currently available and, whenever possible, some lessons arising from their application. Section III deals with choosing an economic valuation method. The final section (IV) outlines some considerations for the Panel's attention and seeks its guidance for defining directions for future work on the subject.

I. VALUATION OF FORESTS IN CONTEXT

12. The context in which efforts to manage forests sustainably are taking place is one of increasing competition for scarce resources, particularly natural resources, and of concern for the fate of natural forests. 2/ Decision-making by Governments, private enterprises, local communities and farmers concerning the conservation, management and utilization of a resource are largely influenced by the value they attach to this resource and the costs and benefits involved in its utilization - or non-utilization. Valuation of forests is therefore about increasing the knowledge of the range of values associated with forests. It provides useful information to all those associated with decisions and choices among management options and alternate uses of forests and lands that meet the needs of the groups involved. It must be stressed that valuation is intended to be a neutral analytical tool and not an advocacy instrument.

13. This report focuses on economic values associated with forests and woodlands, that is to say, values to which some monetary measure can be assigned. This is not to deny that other types of values must be recognized such as social, ethical, cultural and religious ones, and that these should be taken into consideration. However, in most cases the principal questions that decision makers, be they government officials or community leaders or private entrepreneurs, ask will deal with economic values rather than with all relevant values and their interactions; for example, what is the nature of economic values and their usefulness? What are the underlying costs and benefits? How can they be used as a basis for comparing options and deciding on them? It is important to stress that economic value measures are primarily useful in comparing and making decisions on changes, in other words, in prioritizing

practical action including alternative uses of forests as well as investments and, ultimately, change in land use. Valuation might also be required for setting levels of possible compensation to those who are obliged to conserve forests beyond their own needs or to refrain from using their full production potential. The valuation approach will therefore be shaped by the decision-making context within which the information is to be used and will focus on answering the basic questions when comparing a proposed change with the status quo. In a case where no change is envisaged, valuation measures are not required for other than curiosity purposes.

14. Economic values have been associated with forestry in the past, in keeping with the traditional orientation of forest management which was towards production of timber and other products for the market. Market prices were thus considered to be the source of information determining the value of forest production. There has been an increased realization of a wide variety of goods (foods, fuels, medicines, fodder, and so forth) and services (land and water protection, amenity and aesthetics, biological diversity, influence on the biosphere, and so forth); however, the traditional valuation methods cannot capture many of those goods and services which are non-marketed or non-marketable, or intangible, or relate to benefits derived outside the forestry sector or to influences on it that are external. The relevance of these goods or services at the local level must be identified; however, the relevance of others are of a wider nature such as encompasses the national, transboundary regional or global level.

15. There are no absolute values, as they are based on perceptions by individuals and groups which are subject to dynamic changes in their situation, needs and aspirations. These perceptions in the particular case of forests have been evolving rapidly in recent years with the broadening of interests, the increasing number of interest groups, the diversity of perceptions by different groups and the awareness of the wide range of goods and services provided by forests at local, regional, national and global levels. Furthermore, values involve costs and benefits whose distribution among interest groups is often a significant element in terms of its political nature and of making decisions. The social and environmental impacts may also change rapidly and the direction of change may be different for the various groups affected.

16. In an increasingly populated world with growing needs for land to grow food and agricultural crops, the sustainability of forests and their management must also be seen in relation to that of alternative uses of the land. The decision depends on efficient land capability assessment and on "clearing-house" arrangements for major land-use changes that take into account other factors which could be even more important than land capability. Socio-economic and physical data provided by forest and other land-use assessments are needed for proper valuation of forests and to enable comparisons with the valuation of other use options for decisions in a sustainable livelihood perspective. Valuation of forests must therefore be seen not as a necessity within a narrow sectoral context but as part of a broader effort covering alternative land uses. This approach provides the necessary base for moving towards sustainable land-use systems within which forests are clearly recognized as an option with its own validity in contributing to sustainability at local, national and global levels.

II. REVIEW OF METHODOLOGIES

17. A review of the literature indicates an eagerness in attempting economic valuation. Studies whose aim was to value recreational goods and services were carried out in the United States of America as early as the late 1950s and 1960s. Recently, one may note a new and widespread interest in finding out what the value of forests might be, and also much confusion. This is hardly surprising, given the complexity of the issue and the practical problems in the way of establishing such values. The classical and neoclassical economic theory on which conventional analysis bases its conceptual framework did not pay attention to environmental problems. They were viewed as externalities or side-effects. Thus, conventional analysis has often failed to adequately capture many forest benefits that do not enter the market or cannot for other reasons be adequately valued in economic terms or are perceived in other sectors.

18. In response to the limitations of traditional approaches for the valuation of forest goods and services, new techniques have been developed which are often faced with inadequate data and knowledge about economy-environment interactions. While some of them are attractive in theory, they are also difficult to apply in practice and often expensive and time-consuming. As has already been stressed, the estimation of the total economic value of forest resources faces difficulties in terms of placing monetary values on unmarketable or intangible goods and services and reflecting the variety of the perceptions of interest groups. In many cases, economic valuation methods provide estimates of values in orders of magnitude. Although values expressed in monetary terms facilitate comparison they should be used with care as they may provide only a partial analysis and be misleading in decision-making.

19. Conceptually, the total economic value (TEV) of a forest is equal to its (a) total use value (TUV) plus its (b) total non-use value (TNV). Use value can be divided into direct use value (DUV), indirect use value (IUV) and option value (OV) (it is important to stress that these values are intended net of costs). These relationships can be expressed as:

$$TEV = TUV + TNV$$

and (where NUV is non-use value)

$$TEV = (DUV + IUV + OV) + NUV$$

DUV can be subdivided into consumptive values, for example, timber, fuelwood and non-wood forest products, and non-consumptive values, for example, recreational activities and sightseeing. IUV covers services, that is, ecological functions performed by forest resources, for example carbon fixation, water-flow regulation, climate regulation and biodiversity. Existence value (EV) is basically people's decision to value the existence of the forest resource coupled with the intention not to use it in future or to keep it available as, among other things, a contributor to the preservation of biological diversity and a source of supply of genetic resources. OV and NUV are associated with people's option to use the forest, or merely have it available, in the future. They are unrelated to use values - in fact, they are much more linked to

cultural elements, including moral and ethical beliefs as well as altruistic motives. Even if measuring them in economic terms is difficult, they should be recognized in valuing the contributions of forests to human welfare.

20. A summarized presentation to facilitate the understanding of the different values associated with forest contributions to human welfare is given in annex I.

21. A range of different valuation techniques exist. Before presenting them, it must be stressed that the actual issue is not so much that of their theoretical appropriateness but of the easiness and reliability with which analysts can attach realistic values to parameters and so derive results that are sensible and replicable under difficult data conditions. Especially important is the capacity of a given methodology to yield good results relatively free from analyst bias in a situation without market signals.

22. Valuation techniques need also to be examined in relation to their applicability to a number of specific categories of situations in which value information is particularly critical for decision-making. Examples of such categories are a major change in forest utilization such as the establishment of a forest reserve for the protection of biological diversity, the afforestation of denuded land, a major change in land use affecting forests or woodlands, agroforestry, watershed management, the conservation of forests for the stability of the biosphere and as a contribution to the global carbon balance, and so forth.

23. Valuation techniques were initially utilized in the United States and Canada, later in Europe and more recently in developing countries. The main techniques vary from those that rely on actual market prices to those that rely on hypothetical methods. These techniques include market prices, efficiency (shadow) prices, hedonic pricing, the travel cost method, the production function approach, related goods approaches, constructed market techniques, and cost-based valuation. Most of them have been already applied in a developing-country context. Detailed reviews of each one can be found in the literature (see annex II for a summary of these techniques and their advantages and disadvantages).

A. Market prices (for traded economic goods and services)

24. Market prices are the result of an interaction between consumers and producers over the demand and supply of goods and services. If this transaction is carried out using currency, the value established in the market is the market price. The assumption underlying this is that these prices reflect economic scarcity and hence are economic efficiency prices. However, this is not always true. Generally, there are distortions in the market prices. These distortions can be attributed to taxes, subsidies, exchange rates and so on. When this exists, appropriate adjustments are required. The derivation of adjusted prices (commonly called shadow prices) is well discussed in any standard project analysis handbook. However, if the transaction is carried out by some form of barter or exchange without the use of currency, the value established in the market is the market exchange value.

25. A study in Amazonian Ecuador 3/ estimated the present value of net revenue based on the potential extraction of non-timber forest products (NTFPs), seven fruits, three medicinal barks and one resin. It was carried out using market prices techniques in three one-hectare permanent primary forest plots at the Jatun Sacha Biological Station in the Upper Napo region of Amazonian Ecuador. These estimated values were compared with the returns from alternative land uses, namely wood extraction and cattle ranching in these areas. The study concluded that the current value of net revenue from NTFP collection was US$ 2,830 in the upland plots and US$ 1,257 in the alluvial plot, and these returns were significantly higher than those from alternative land uses in this area. The authors called attention to the fact that the results of the study also raised an important paradox: if the value of NTFPs exceeded alternative land uses, why did the region seem so little intent on adopting these NTFP-related uses? This paradox raises another question regarding the meaning of value per se? The results of the study suggest that valuing a piece of forest must be complemented by other measures to turn these values into revenue flows.

B. Efficiency (or shadow) prices (for effective/efficient resource allocation)

26. The market price does not necessarily mean the "proper" price and/or reflect the true economic efficiency price. There are market and policy failures that can distort market prices. Market failures concern to the inability of market prices, under certain conditions, to reflect accurately the value of environmental goods or services; for example, the upstream polluter has no incentive to account for the costs he imposes on a downstream user of the river. Policy failures concern instances where government policies have unintended effects, or sometimes even side-effects or cause resource-use behaviour inappropriate from a societal perspective (for example, when subsidies given by Governments for the use of resources that lead to or encourage resource overuse).

27. In financial analysis, no account is taken of any of these failures that distort market prices. Therefore, it is advisable to look at their economic value in order for their value to society as a whole to be reflected, as in the case, for example, of alternative forest land uses. To do so, the market price is adjusted. There are various methods for correcting market and policy distortions. The derivation of adjusted prices which are commonly called shadow prices, is well discussed in any standard project analysis handbook.

28. Shadow prices should be cautiously used because:

(a) Market prices are often more readily accepted by decision makers than artificial values derived by the analyst;

(b) Market prices are generally easy to observe, both at a single point and over time;

(c) Market prices reflect the decision of many buyers, whereas calculating shadow prices often relies on the objectivity of judgement of the analyst;

(d) The procedures for calculating shadow prices are rather imperfect and therefore estimates can, in certain cases, introduce larger discrepancies than even the simple use of imperfect market prices.

29. Thus each case should be analysed within the context in which the valuation is being made, and should take into account the data and resource constraints. There cannot be a simple blueprint for every case.

C. Hedonic pricing method (for non-marketed goods and services)

30. The hedonic pricing method is one of the systems that use a surrogate market to input the value of non-marketed goods and services; for example, the market value differences for similar forest properties are used to reflect the value of some environmental services or costs that varies across the properties. There are some limitations to this method, in so far as caution needs to be applied. One of these limitations involves the fact that there is little evidence to date to indicate that land, labour or other market prices are sensitive to the environmental amenities provided by forests. Furthermore, its data requirements are substantial and the forest resource, function or attribute being valued needs to be well known and easily measurable.

31. This method has been applied in developed countries, for example, to estimate the costs of air and noise pollution and of changes in amenities. However, given the fairly stringent assumptions on which this method is based and its data requirements, countries need to have a fairly good knowledge of their forest resource. In many countries, it will require significant effort to build the skills needed for analysis as well as for deriving the kind of results leading to effective decision-making and planning.

D. Travel cost method (effort/cost for consumers to obtain goods/services)

32. This method recognizes that for some goods or services the consumer may have to incur substantial cost (in time or money) to obtain a particular good or service. It assumes that the value to the consumer is at least equal to the travel costs the consumer is willing to incur to obtain the desired good or service. For example, a recreational experience may involve significant travel expenses; and gathering free fuelwood may require a considerable amount of time. This method has been used extensively in developed countries, especially in the United States, since the 1950s and 1960s, to value recreational goods and services. More recently it has also been carried out in some developing countries. However, despite the improvements in this method effected since its early application, its usefulness in valuing alternative recreational uses is still constrained by a number of factors. These factors are mainly the large amount of data required, the restrictive assumptions about individuals' behaviour and the sensitivity of the results to the statistical methods used to specify the demand relationship. It is also important to bear in mind that gathering free fuelwood is not necessarily a function of the consumer's willingness to incur travel costs in order to obtain the fuelwood. On the contrary, it is much more a consequence of his/her state of poverty. In other

words, since around the world the consumer is too poor to be able to afford to pay for the fuelwood, he/she needs to travel long distances to gather it free.

33. An example of application of the travel cost method in the context of tropical forests can be found in the estimation of the value of ecotourism to domestic users of the Monteverde Cloud Forest Biological Reserve in Costa Rica.

E. Production function approach (to capture indirect, for example, ecological, values)

34. The production function approach to valuation may be used to capture the indirect use value of regulatory ecological functions of tropical forests through their contribution to economic activities. This approach consists of a two-step procedure. First, the physical effects of the environment on economic activity are determined. The second step consists of estimating the monetary value of the ecological function. For example, the cost of siltation of irrigation canals can be expressed in terms of reduced availability of water for crop production. A loss of net farm income thus defines the extent of the damage imposed by upstream erosion. As another example, consider the wind-break: it can increase crop values behind it, and those increased values can be taken as a proxy measure of the minimum value of the benefits from the wind-break (there may also be others, such as fodder, shade for cattle, and so forth). In its most straightforward applications, this method uses actual market prices - or, when distortions exist, appropriately modified market prices - to value economic production.

35. Applying this approach to the various indirect uses of forests is a useful method of estimating these non-marketed, but often significant, economic values. This method has been used extensively in developed countries and frequently in developing regions to estimate the impact of deforestation, soil erosion, wetlands and reef destruction, and air and water pollution on agriculture, forestry, fisheries, health and materials damage. However, it is a prerequisite that the relationship between the environmental regulatory function of the forest and the economic activity it supports be well understood. Frequently, this relationship is not well understood, and a slight change in assumptions leads to a drastic change in results. For instance, in relation to the timing of sedimentation, most valuation studies assume that sedimentation will be reduced in the first year and that benefits will occur in the near future. This means that their net present value is fairly significant. However, many soil stabilization benefits may occur only after some years, if not decades. The net present value is, in this case, rather small. In addition, the impacts of market conditions and regulatory policies affecting production decisions need to be taken into account in the application of this approach.

36. Applications of the production function approach may be most straightforward in the case of single use systems, for example, forests in which the predominant economic value is a single regulatory function. In the case of multiple use systems, for example, forests in which a regulatory function may support or protect many different economic activities, or those that may have more than one regulatory ecological function of economic value, applications of this approach are slightly more problematic. In particular, assumptions

concerning the ecological relationship among these various multiple uses must be carefully constructed.

37. This approach was employed to value the ecological benefits of rural afforestation programmes in northern Nigeria.

F. Related goods approaches (to estimate values indirectly)

38. A non-marketed good or service may be related to a marketed good or service. By using information about this relationship and the price of the marketed product, the analyst may be able to infer the value of the non-marketed product. This broadly defined related goods approach consists of three similar valuation techniques: the barter exchange approach, the direct substitute approach, and the indirect substitute approach.

1. Barter exchange approach (to estimate the barter value of, for example, wild mushrooms)

39. There are many forest products that are not widely traded in formal markets, for example, wild fruits, nuts and vegetables, medicines and structural fibres. However, some of these forest products may be exchanged on a non-commercial basis through a process of barter. If the bartered good that is exchanged for the forest product is also sold in a commercial market, then it may be possible to derive the value of the non-marketed good using information on the relationship (that is, the units of exchange) between the two goods and the market value of the commercial good. For example, consider a situation where leafy vegetables are harvested from the tropical forest and consumed locally but not sold in the local market. Given that leafy vegetables are non-marketed goods, it is not possible to value these goods directly using market prices. However, if a basket of leafy vegetables of known weight is routinely exchanged for six eggs through a process of barter and six eggs fetch US$ 1 in the local market, then it can be inferred that the basket of leafy vegetables is worth US$ 1; that is, the market price of the marketed good is used to estimate indirectly the value of the non-marketed good.

40. As with all valuation techniques, care must be taken in applying this approach. For example, bartering may occur in an "imperfect" non-commercial market and the rate of exchange may reflect a wider range of socio-economic factors than just the value of the goods exchanged. There are few, if any, studies that have attempted to infer the value of a forest product from the marketed value of a bartered good. However, this should not exclude the technique from being considered a potentially useful valuation approach, especially in developing countries where bartering is common.

2. Direct substitute approach (to estimate the value of, for example, fuelwood)

41. If forest goods used directly are non-marketed (for example, fuelwood), then the value of their use may be approximated by the market price of similar goods (for example, fuelwood purchased from other areas) or the value of the next best alternative/substitute good (for example, kerosene or charcoal). 4/ The extent to which the value of the marketed good reflects the value of the non-marketed good depends, to a large extent, on the degree of similarity or substitution between the two goods. That is, if the goods are perfect substitutes then their economic values should be very close. As the level of substitution decreases, so does the extent to which the value of a marketed good can be taken as an indication of the non-marketed forest good. Once again, market imperfections may distort the economic value of the good or service reflected in the market-place.

42. The substitute good approach has been used for the economic valuation of wetland benefits in the Hadejia-Jama are flood plain of north-east Nigeria.

3. Indirect substitute approach (to compare a non-marketed good/service with a close substitute)

43. The techniques presented above are not always applicable in remote areas and rural settings in developing countries. An alternative but second-best approach to valuation is the indirect substitute approach, which does not relate directly to willingness to pay.

44. The indirect substitute approach is similar to the direct substitute approach but requires one additional step in the valuation procedure. This additional step consists essentially in combining the production function approach with the direct substitution approach. That is, if a non-marketed forest good has a close substitute then it may be possible to derive the value of the non-marketed forest good from the value of the substitute good. However, if the value of the substitute good cannot be determined directly from the market then it may be possible to derive its value indirectly, by analysing the change in value of economic output caused by a change in the use of the substitute good as an input into production.

45. However, the indirect substitute approach is necessarily based on fairly stringent assumptions about the level of substitution between the two goods, the role of the substitute good as an input into economic output, and the value of the economic output. This technique is also fairly data-intensive. Given the tenuous link between the item being valued and the actual valuation procedure and the heavy data requirements, this approach can be expected to provide only rough indications of value.

46. This approach was applied in a cost-benefit analysis of a management programme for two forested watersheds in Nepal. Fuelwood was valued in terms of the alternative uses of its closest substitute, namely, cattle dung, which can be dried and burnt when wood is unavailable. The opportunity cost of using cattle dung as fuel rather than as fertilizer was estimated in terms of losses

in food grain production resulting from lower dung inputs into agricultural production.

G. Constructed market techniques (hypothetical "willingness to pay")

47. Constructed market techniques measure individuals' willingness to pay (WTP) to continue receiving benefits, or their willingness to accept (WTA) compensation in return for forgoing benefits. This is done by presenting people with a hypothetical or simulated market situation and either directly eliciting consumer preferences for the object of the valuation or obtaining preference orderings which can then be anchored to a revealed preference. 5/ It is important to note that both evidence and theory indicate that, for a particular measurable change in the provision of a good, measures of WTA and WTP will not necessarily be identical - WTA will exceed WTP. The use of WTA as a measure of economic welfare in examining unique environmental goods has been questioned since the difference between WTP and WTA is likely to be particularly large in such cases.

48. Within this context, some caution should be exercised in the use of WTP and WTA. First, an accurate initial identification of the object, or property right, that is being measured must be made. This should lead to a proper assessment of whether a measurement of WTP or WTA is called for. Second, as they do not measure the same property right, it is important to avoid taking WTA as a measure of WTP, and vice versa.

49. The simulated market technique could be applied, for example, to the valuation of tropical forests as a means to investigate option and existence values held by non-tropical populations. The usefulness of such an investigation to the tropical country owner of the resource is not clear. What is the purpose of a survey to determine WTP and/or WTA, for example, to preserve the Amazon forest if the person does not even know where exactly the Amazon is located? On the other hand, the person can answer in terms of any value since he/she is not actually going to pay anything. However, would this value be the same if he/she had to actually pay? Beyond this one possibility, these techniques are as yet of limited usefulness in evaluating natural resource issues in developing countries as regards the task at hand.

1. Contingent valuation method (a consumer's perceived value of a good/service)

50. Interest in the contingent valuation method (CVM) has increased over the last decade or so. CVM techniques use one of two measures of consumer's surplus: compensating variation (CV) or equivalent variation (EV). CV is the amount of payment or change in income necessary to make an individual indifferent with respect to an initial situation and a new situation with different prices. EV may be viewed as a change in income equal to a gain in welfare resulting from a change in price. This method is used to estimate the consumer's WTP for a specified good or service or WTA compensation for receiving an undesired good or service. In practice, it is usually derived from the

responses of potential consumers to a hypothetical exchange situation. The method assumes that the consumer's expressed WTP in a hypothetical situation is a measure of the value to the consumer in an actual situation. It is particularly difficult to apply meaningfully when the respondent is asked to express a value for many functions of the forest that have no established monetary market value, such as provision of cleaner water, which might become available in a hypothetical set of circumstances, such as through reduction in upstream harvesting activities.

51. Applications of CVM to ecotourism in the market of developing countries illustrate the use of this technique. For example, a report on a survey of option and existence values conducted at Khao Yai Park in Thailand was based on this approach. In a CVM study of the viewing value of elephants in the Kenyan national parks, WTP for current levels of elephants in Kenyan parks was estimated. The value of ecotourism at a tropical rain forest site in Costa Rica was based on this approach. Another example from Costa Rica was a study that used a "take-it-or-leave-it" personal interview survey to establish WTP for the Monteverde Cloud Forest Preserve. 6/

2. Contingent ranking method (using relative instead of absolute values)

52. The contingent ranking method differs from other methods in that it does not ask respondents to place a monetary value on the environmental amenity itself. Instead, a range of amenities are ranked and then scored relative to each other, with one of the amenities serving as an "anchor". The respondents' WTP for the anchor is then elicited and used in inferring their WTP for the other amenities. The valuation of multi-purpose tree resources in Zimbabwe involves an excellent example of this technique. Zimbabwean smallholder farmers were asked to rank and score 10 categories of commodities obtained from trees. These non-monetary preferences were calibrated by simultaneously asking respondents to score a hand-pump borehole and a well-known type of pit latrine. Respondents were then asked for their WTP for the borehole and latrine in order to provide an "anchor" for use in inferring the value of the forest products and services.

53. The contingent ranking method has obvious merits in the context of evaluating alternative land-use options. However, it is important to bear in mind that due to its "indirect" approach, contingent ranking does not necessarily provide true estimates of WTP. Cross-checking of both contingent ranking and other CVM methods may be required in order to provide an indication of the reliability of the value estimates produced.

H. Cost-based valuation (what it would cost to provide the goods/service by other means)

54. A final set of valuation techniques for non-marketed goods and services can be grouped together under the heading of "cost-based valuation". These techniques assess the costs of different measures that would ensure the maintenance of the benefits provided by the environmental good or service that

is being valued. These cost estimates are then used as proxies for unknown environmental benefits.

1. Indirect opportunity cost (for example, labour cost of gathering fuelwood)

55. The indirect opportunity cost (IOC) method is used to calculate the value of non-market environmental goods when individual labour is involved in harvesting or collection. The basic assumption of this technique is that the decision to spend time in the collection and harvesting of, for example, NTFPs is weighed against alternative productive uses of labour. The use of the IOC method to value firewood gathered from the forest in Nepal has been described. Such a technique assumes that harvesting and collection of NTFPs generally require the expenditure of human effort with only minor investments in capital equipment. However in many cases it is almost impossible to assess how much labour is used for collecting NTFPs. For example, how often do farmers collect NTFPs on their way to a field? These "user cost-based techniques" suffer from the same deficiency - what something is worth has no necessary relationship to the costs involved to produce it. The fact that it is hard to estimate the users' cost to produce, for such joint products as NTFPs in the informal sector, makes this technique somewhat dubious.

2. Restoration cost (what it would cost to recreate the original ecosystem)

56. The restoration cost technique is based on the idea that given an alternative land-use option the non-marketed benefits provided by an intact ecosystem or the particular goods and services provided by such an ecosystem can be measured by estimating what it would cost to re-create the original ecosystem (or environmental good or service). The assumption is that by restoring the original ecosystem the original level of benefits will be restored.

57. In the case of primary forests, this method would involve costing the restoration of the original forest cover. Clearly, this is not something that, even with active intervention in silviculture and forest management, could be concluded quickly if it could be accomplished at all. Such considerations suggest that the technique is unlikely to prove useful.

3. Replacement cost (what it would cost to replace the good/service)

58. A perhaps more realistic method of re-creating non-marketed benefits consists in replacing specific natural ecosystem functions or assets with man-made production processes and capital, instead of relying on the restoration of the original ecosystem or function to provide the original level of benefits. This technique generates a value for the benefits of an environmental good or service by estimating the cost of replacing the benefits with an alternative good or service. It rests on the availability of such an alternative for the original good or service. The alternative should produce, as nearly as

possible, the same level of benefits supplied by the resource or environmental function being valued. 7/ This technique rests heavily on the assumption that replacing the original good or service is worthwhile, and that the benefits generated by the investment in replacement outweigh the costs of replacement.

4. Relocation cost (cost of moving people to where the original good/service still exists)

59. This technique involves estimating how much it would cost to relocate (and re-equip) communities in order that they might obtain a level of benefits in their new location similar to those derived at their original site. Instead of investigating the cost of bringing substitute benefits to populations in existing sites, this technique examines the potential for moving people to alternative locations where such benefits exist.

60. Application of the relocation cost technique to forests is typically restricted to a different purpose, namely, assessing the direct costs of establishing new protected areas that require the resettlement of forest-dwelling communities.

5. Preventive/defensive expenditure (what it would cost to prevent degradation)

61. A cost-based approach to estimating environmental benefits by examining preventive expenditures involves obtaining a figure for what it would cost to maintain environmental benefits by investing in the prevention of their degradation. For example, in the case of a selective harvesting regime, the watershed protection benefits that would be lost by building logging roads for the extraction of logs from the forest could be valued by examining what it would cost to select less damaging extraction techniques such as non-mechanized extraction or even extraction by helicopter.

62. In concluding this section, it is necessary to stress that no methodology provides a comprehensive answer, and this point is exemplified by a conservation project whose preparation used a combination of valuation methods to facilitate decision-making. The example 8/ was one of environmental valuation of a forestry development and conservation project in Madagascar. Its study contributed to raising awareness of the need for improved valuation methods for natural resource projects. It allowed some valuation methods to be adapted for use in economic analysis of a conservation project. To carry out the research, the following valuation methods were used: the contingent valuation method, recreation demand analysis (travel cost method), opportunity cost analysis and productivity analysis. This study has shown the potential of several valuation methods for improving the economic analysis of projects. However, as was noted by the authors, a study of this scope is impractical for every environmental or natural resource project. In fact, it is a project in itself.

III. CHOOSING THE ECONOMIC VALUATION TECHNIQUE/METHOD

63. All the techniques and methods presented above have fairly wide applicability. They cannot be prescribed a priori since the choice is dependent on many factors. However, any of them, used appropriately, should produce results that can be employed in a decision-making context. As already stressed above, the main use for monetary measures of forest values is as information on which to base comparisons of, and ultimately decisions on, proposed changes in forest management and use. However, the application of economic valuation techniques to the full range of forest benefits is an area that needs much more development. Certain recent studies illustrate the appropriate application of these techniques, but much more empirical work is required. In short, the following stages should be considered when choosing the economic valuation technique/method to be used.

64. The first stage in the evaluation process consists in defining clearly the overall objective or problem at hand. The type of economic assessment approach chosen will directly depend on the problem confronting the analyst. It is important to understand the decision-making context before moving on to the attempt to measure or estimate economic values. The values needed and the best way to estimate them will vary with the decision-making context.

65. After the appropriate economic assessment approach is identified, the next stage consists in defining the analysis and information required to conduct the assessment. The first step is to identify the area under consideration (whether an existing forest or possibly an area to be reforested or forested) the time-scale of the analysis, and the geographical and analytical boundaries of the system. It is also important to identify the various interest groups involved or affected by a proposed change and then define their own value perspectives that need to be taken into account in the decision-making process. These will obviously differ given the type of problem to be analysed. Once the analytical boundaries have been set, the economic values within these boundaries of relevance to the assessment need to be identified. It is therefore helpful to distinguish among different types of values: direct use, indirect use and non-use values. Identifying system and analytical boundaries, listing similar and conflicting values by interest groups and ranking them in terms of their importance to the assessment are all important steps in defining the information required for the analysis. As an example, consider the proposal to open a given forest area for logging. Some obvious interest groups would be the proposed loggers, the indigenous populations that live in the forest area, the county or province that owns the forest (and would thus gain revenue), various environmental groups, and the consumers of timber products, particularly if the increased logging resulted in lower prices for consumers.

66. The final stage involves carrying out the actual assessment itself. Priority should obviously be given to assessing those values that are more relevant to the decision-making requirements. Constraints on time, finances and skills will affect which goods and benefits can be valued and to what degree of accuracy. For example, a resource, function or characteristic may be given high importance initially, but other constraints may prevent its valuation.

67. Some guidelines exist for using economic value measures in practice. Gregersen and others (see note 1 below) suggest a general approach for the public sector that can be used in sorting out the values of different interested groups and their importance in different decision-making contexts.

68. As a final remark on difficulties encountered, it may be useful to refer to an example of estimating the total economic value (TEV) of forests. A study conducted in Mexico 9/ meant for this purpose showed an annual lower bound value of the services of Mexico's forests to be in the order of US$ 4 billion. TEV is an aggregate of direct-use value plus indirect-use value plus option value plus existence value. As such, this value encompasses benefits of Mexico's forests that accrue spatially (locally, nationally, regionally and internationally); so of this total value only a portion is likely to be "captured" within the country while most of it, for example, carbon cycling, will fall outside its borders. One of the conclusions of that study was that it had demonstrated that a strong case could be made for forest conservation in the Mexican instance, based on local, regional and global values of forests, and that those values should be incorporated into decisions on the future management of such an important resource. This leads once again to the question how the country can actually capture such values. As was pointed out in the study, valuation by itself is of little interest to a country owning environmental assets unless they can be turned into revenue flows. Thus, appropriate mechanisms need to be developed to capture the estimated economic values. These mechanisms need to be at the national and the international level.

69. There are many more case-studies. These studies suggest that such valuation techniques, with proper adaptations to a local context, can be useful in assessing resource value changes in the context of developing countries.

IV. ISSUES FOR FURTHER CONSIDERATION

70. This brief review suggests that (a) from a technical point of view, there exists a large body of techniques, methodologies and approaches for dealing with forest valuation, although some of them are too theoretical, and difficult to apply as well as time-consuming and costly; and (b) some experiences of the application of valuation techniques exist from which lessons can be drawn. One must also stress that the application of even the most traditional valuation methods relies heavily on the availability of better data, part of which should originate from the assessment of forest resources. It is critical that the information not be restricted to the forest sector: it should also be linked to other sectors that capture benefits generated by forests and woodlands.

71. However, a number of important considerations that go beyond technical aspects are brought to the attention of the Panel in terms of discussing this topic:

(a) Is the information provided by valuation efforts worth the use made of it in decision-making. In other words, it is necessary to ask whether elaborate valuation is able to influence decisions; otherwise it is a wasted effort;

(b) It should be noted that valuation always takes place in a context of power relationships among policy makers, society and various types of interest groups and communities. The power relationships determine whose perspective ultimately prevails in valuation;

(c) More detailed analysis is required for assessing the applicability and reliability of valuation in the key situations in which valuation is important that are probably more central to the concerns of the Panel such as (i) utilization or conservation of primary, unmanaged or any other types of forests, (ii) establishment of reserves for biological diversity, (iii) carbon sequestration and (iv) international watersheds, among others;

(d) Once value is demonstrated and incidence of such benefits is shown to be supranational, the political question, not a valuation issue, is whether - and if so how - to compensate those who suffer by making the value stay available, for example, with respect to areas under conservation that go beyond national and local needs;

(e) It is important to ensure that valuation is used as an objective analytical tool relative also to other sectors and to avoid "valuation for advocacy". The danger may exist that valuation is being applied selectively to forests for the purpose of advocacy rather than of neutral analysis relative to other uses of the lands with which forest-related uses are compared.

72. As was stressed in the introduction to this report, valuation is not a panacea in terms of stopping deforestation or forest degradation. It is a useful tool for providing information relating to a comparison of values (of those that would exist with a proposed change with those that would exist without one) and to the different ways different interest groups would be affected. The strength of valuation techniques lies in their ability to improve the understanding of the multiple goods and benefits of forests and the differences in the perceptions of and the importance given to, those goods and benefits by different interest groups. Their usefulness is determined by the existence of the political commitment to use the information generated for effective decision-making with a good understanding of the likely impacts. Even so, review shows that many of the detailed applications have been produced by researchers at a cost, both in time and in money, that would make such techniques of little use to managers having to make everyday decisions.

73. It is suggested that the Panel may wish to pay special attention to deciding if its interest is to be centred in (a) further work on valuation stricto sensu, which would imply that continuing efforts are justified by a demand for full valuation encompassing other dimensions than those incorporated in traditional methods in order to actually influence decisions. The Panel may wish to consider whether forest valuation theory and methodology are not ahead of actual applications. On the other hand, most valuation studies suffer from insufficient data and limited understanding of economy-environment interactions. The complexities of social systems and the valuation of social goods and services are seldom considered fully. If the Panel considers that there is scope for more work for improving valuation techniques, it may wish to indicate what emphasis it would like to see for research on alternative ways of bringing interested groups and stakeholders together and tools that allow people to

communicate what they value most and on work at national, regional and global level or in (b) the political issues raised once value is established, in other words, how to direct serious attention towards the outcome of valuation, its application and the implications for decision-making and for reconciling the concerns of the various interest groups or stakeholders. More specifically, the key challenge lies in developing policies and influencing behaviour on the basis of approaches that address the matter of the values forests provide, that meet the competing demands of interested groups and that provide a tool for analysis, and, ultimately, in making decisions and directing action in a coherent manner among major players and interest groups.

74. Including forest values within systems of national accounting is the next step to be addressed once agreement has been reached that it is feasible to derive credible, objective valuations that include all non-market goods and services.

Notes

1/ Official Records of the Economic and Social Council, 1995, Supplement No. 12 (E/1995/32), chap. I, annex I, sect. III, para. 1.

2/ For a more detailed and complete presentation of the subject of this report please see Gregersen and others, Valuing forests: context, issues and guidelines, FAO Forestry Paper, No. 127 (Rome, 1995). This paper was jointly sponsored by the World Bank, the United Nations Environment Programme (UNEP), a project of the United States Agency for International Development (USAID) and FAO.

3/ A. Grimes and others, "Valuing the rain forest: the economic value of non-timber forest products", Ambio, vol. 23, No. 7, pp. 405-410.

4/ The surrogate market valuation approach uses information about a marketed good or service to infer the value of a related, substitute or comparable non-marketed good or service under comparable conditions. For example, the value of fuelwood in a new market is estimated on the basis of the value of an alternative fuel, for example, kerosene, in that market, after adjusting for the calorific value of the two fuels.

5/ Carson (1991) provides an excellent overview of constructed markets.

6/ For a more general view of CVM as a method of valuing natural areas, see, for example, Valuing Natural Areas: Applications and Problems of the Contingent Valuation Method, Proceedings and related papers from a workshop held on 29 and 30 June 1992, M. Lockwood and T. DeLacy, eds. (New South Wales, Australia, Charles Stuart University, 1993).

7/ The difference between the replacement cost method and the substitute good method is that the latter rests simply on establishing the market price of a substitute. The replacement cost approach involves actually estimating what it would cost to replace a good or service.

8/ R. A. Kramer and others, Valuing Tropical Forests: Methodology and Case Study of Madagascar, World Bank Environment Paper, No. 13 (Washington, D.C., World Bank, 1995).

9/ W. N. Adger and others, "Total economic value of forests in Mexico", Ambio, vol. 24, No. 5, pp. 286-296.

Annex I

VALUES ASSOCIATED WITH CONTRIBUTIONS OF FORESTS TO HUMAN WELFARE

Direct use values associated with:

Consumptive uses:

Commercial/industrial market goods (fuel, timber, pulpwood, poles, fruits, animals, fodder, medicines, and so forth);

Indigenous non-market goods and services (fuel, animals, skins, poles, fruits, nuts, and so forth).

Non-consumptive uses:

Recreation (jungle cruises, wildlife photography, trekking, and so forth);

Science/education (forest studies of various kinds).

Indirect use values associated with:

Watershed protection (protection of downstream areas);

Soil protection/fertility improvements (maintenance of soil fertility, especially important in tropical regions);

Gas exchange and carbon storage (improvement of air quality, reduction of greenhouse gases);

Habitat and protection of biodiversity and species (potential drug sources, source of germplasm for future domesticated plants and animals);

Soil productivity on converted forest land (space and soil productivity for agricultural/horticultural crops and livestock).

Option and existence values:

People may value a forest or resource complex purely for its existence and without any intention to directly use the resource in the future. This includes intrinsic value;

People may value the option to use a forest in the future, or merely the option to have it available in the future. Although such values are difficult to measure in economic terms, they should be recognized in valuing the contributions of forests to human welfare.

Note that any of the above values can be considered at different scales, for example, catchment, forest, watershed, regional, national, global.

Source: Gregersen and others, Valuing Forests: Context, Issues and Guidelines, FAO Forestry Paper, No. 127 (Rome, 1995).

Annex II

ADVANTAGES AND DISADVANTAGES OF VALUATION TECHNIQUES IN FOREST LAND-USE APPRAISAL

Valuation technique	Advantages	Disadvantages
Market prices		
Use prevailing prices for goods and services traded in domestic or international markets	Market prices reflect the private willingness to pay for costs and benefits of forest land-use options that are traded (for example, timber, fuelwood, food, medicines, utensils, recreation). They may be used to construct financial accounts to compare alternative land-use options from the perspective of the individual or the firm concerned with private profits and losses. Price data are relatively easy to obtain	Market imperfections and/or policy failures may distort market prices which will therefore fail to reflect the economic value of goods or services to society as a whole. Seasonal variations and other effects on prices need to be considered when market prices are used in economic analysis.
Efficiency (shadow) prices		
Use market prices but adjust for transfer payments, market imperfections and policy distortions. May also incorporate distribution weights, where equity concerns are made explicit. Shadow prices may also be calculated for non-marketed goods	Efficiency prices reflect the true economic value, or opportunity cost, to society as a whole, of goods and services that are traded in domestic or international markets (for example, timber, fuelwood, food, medicine, utensils, recreation)	Derivation of efficiency prices is complex and may require substantial data. Apparently "artificial" prices may not be accepted by decision makers
Hedonic pricing method		
The value of an environmental amenity is imputed from property or labour markets. The basic assumption is that the observed property value (or wage) reflects a stream of net benefits (or working conditions) and that it is possible to isolate the value of the relevant environmental amenity or attribute	Hedonic pricing may have potential for valuing certain tropical forest functions (for example, microclimate regulation, groundwater recharge) in terms of their impact on agricultural land values, assuming that the link between forest functions and agricultural productivity is widely known and fully reflected in agricultural land prices	Application of hedonic pricing to the environmental functions of tropical forests requires that these values be reflected in surrogate markets. The approach may be limited where markets are distorted, choices are constrained by income, information about environmental conditions is not widespread and data are scarce

Valuation technique	Advantages	Disadvantages
Travel cost method		
The travel cost approach derives willingness to pay for environmental benefits at specific locations by using information on the amount of money and time that people spend to visit the location	Widely used to estimate the value of recreational sites, including public parks and wildlife reserves. It has been used to estimate willingness to pay for ecotourism to tropical forest areas in some developing countries	Data-intensive; restrictive assumptions about consumer behaviour (for example, trip multifunctionality); results highly sensitive to statistical methods used to specify the demand relationship
Production function approach		
Estimates the value of a non-marketed resource or ecological function in terms of changes in economic activity, by modelling the physical contribution of the resource or function to economic output	Widely used to estimate the impact of deforestation, soil erosion, wetlands and reef destruction, air and water pollution and so forth on productivity activities such as crop cultivation, fishing, hunting and so on	Requires explicit modelling of the "dose-response" relationship between the resource or function being valued and some economic output. Application of the approach is most straightforward in the case of single use systems but becomes more complicated with multiple use systems. Problems may arise from misspecification of the ecological-economic relationship or double counting
Related good approaches		
Uses information about the relationship between a non-marketed good or service and a marketed product to infer value. The barter exchange approach relies on actual exchange of non-marketed goods for marketed goods. The direct substitute approach simply assumes that a marketed good can substitute for a non-marketed good. The indirect substitute approach also relies on a substitute good but if the latter is not exchanged in markets its value is inferred in terms of a change in economic output (in other words, using the direct substitute approach combined with the production function approach)	These approaches may provide a rough indicator of economic value, subject to data constraints and the degree of similarity or substitution between related goods	The barter exchange approach requires information on the "rate of exchange" between two goods. The direct substitute approach requires information on the degree of substitution between two goods. The indirect substitute approach requires information on the degree of substitution and on the contribution of the substitute good to economic output

Valuation technique	Advantages	Disadvantages
Constructed market techniques		
Measure WTP and WTA by directly eliciting consumer preferences	Directly estimates Hicksian welfare measure; provides best theoretical measure of WTP	Practical limitations of constructed market techniques may detract from theoretical advantages leading to poor estimates of true WTP
Simulated market (SM): constructs an experimental market in which money actually changes hands	SM: controlled experimental setting permits close study of factors determining preferences	SM: sophisticated design and implementation may limit application in developing countries
Contingent valuation method (CVM): constructs a hypothetical market to elicit respondents' WTP	CVM: only method that can measure option and existence values and provide a true measure of total economic value	CVM: results sensitive to numerous sources of bias in survey design and implementation
Contingent ranking (CR): ranks and scores relative preferences for amenities in qualitative rather than monetary terms	CR: generates value estimate for a range of products and services without having to elicit WTP for each	CR: does not elicit WTP directly, hence lacks theoretical advantage of other approaches
Cost-based valuation		
Based on the assumption that the cost of maintaining an environmental benefit is a reasonable estimate of its value. To estimate WTP:	In general, it is easier to measure the costs of producing benefits than the benefits themselves, when costs comprise traded goods and services and benefits are non-marketed. Hence cost-based approaches are less intensive in terms of data and resource requirements	
Indirect opportunity cost method (IOC) uses wages forgone by labour in production of non-marketed goods	IOC: useful in evaluating subsistence benefits where harvesting and collecting time is a major input	
Restoration cost method (RSC) uses the cost of restoring ecosystems or goods and services	RSC: potentially useful in valuing particular environmental functions	
Replacement cost method (RPC) uses the cost of artificial substitutes for environmental goods and services	RPC: useful in estimating indirect use benefits when ecological data are not available for estimating damage functions with first-best methods	
Relocation costs method (RLC) uses the cost of relocating threatened communities	RLC: only useful in valuing environmental amenities in the face of mass dislocation such as dam projects and establishment of protect areas	

Valuation technique	Advantages	Disadvantages
Preventive expenditure approach (PE) uses the cost of preventing damage or degradation of environmental benefits	PE: useful in estimating indirect use benefits when prevention technologies are available	
Damage costs avoided approach (DC) relies on the assumption that damage estimates are a measure of value. It is not a cost-based approach, as it relies on the use of the valuation methods described above	DC: first-best methods to estimate damage costs are useful for comparison with cost-based approaches, which implicitly assume damage is worth avoiding	

Source: International Institute for Environment and Development (IIED), 1994.